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# **First ERA-MBT Stakeholder meeting report**

Work Package 6

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## EXECUTIVE SUMMARY

The first Stakeholder meeting of the Marine Biotechnology ERA-NET (ERA-MBT), held in Lisbon, Portugal, on the 28th and 29th October of 2014, gave participants an opportunity to influence the future of the ERA-MBT and to reinforce the network of researchers, industry, policy makers and funding agencies to support the development of European marine biotechnology.

Please note that pdf files of the presentations are given at the ERA-MBT web page [www.marinebiotech.eu/stakeholder-meeting](http://www.marinebiotech.eu/stakeholder-meeting).

## STATE OF THE ART OF MARINE BIOTECHNOLOGY

Several invited speakers gave an overview of different areas contributing to the state of the art of marine biotechnology. In contributing a policy perspective, **Jacques Fuchs**, Deputy Head of Unit F4 - Marine Resources, DG Research and Innovation, European Commission, described the range of EC support actions that contribute to marine and maritime development, and how the Jean-Claude Juncker led Commission, provides many new opportunities for marine biotechnology, since funding for top-level research not only creates jobs, but also ensures that technological progress gives a boost to the economy.

**Torger Børresen** of Innovation Fund Denmark, the Danish ERA-MBT partner, highlighted the marine biotechnology product opportunities and illustrated the market penetration of products originating from the marine environment in areas such as biomaterials, food, pharmaceuticals, etc. The adoption of an even-more strategic approach that would support a “market driven approach” to marine biotechnology would bring a greater research focus to marine biotechnology, and for an optimal use of any raw material it would be necessary to target several markets in a multi-stream processing approach. **Rachael Ritchie**, Director, Business Development, Genome, British Columbia in Canada provided an international perspective on the state of the art of marine biotechnology. In a wide-ranging and stimulating talk, she covered all aspects of the marine biotechnology value chain from addressing the need for expanding the –omics toolbox to the investment potential, governance challenges, sustainability and impacts on global needs.

Bioprocessing of marine biomass may also present a lot of challenges. **Dagmar Stengel**, National University of Ireland Galway, showed how algal biomass on one side is an excellent material for biorefining into a range of products, and on the other side, the ecosystem services they offer. Among the challenges in biorefining marine biomass, specifically algal biomass, eventual success was ultimately dependent on early, clear and correct choices that matched process to desired products; and where these were each appropriate to particular algal species. The strategic dimension to marine biotechnology was covered by **Dermot Hurst** from Ireland’s Marine Institute provided insights to progress made over recent years in developing Europe’s marine biotechnology community. He pointed to the challenges faced by ERA-MBT in developing a strategic roadmap for marine biotechnology including understanding how and where marine biotechnology can add value to marine biomass and enable a shift from commodity to niche products.

**Meredith Lloyd-Evans**, Managing Director Biobridge Ltd, in his presentation ‘Who is investing in Marine Biotechnology’, outlined a diverse international commercial landscape of marine biotechnology and described how investments can help SMEs to grow on the back of marine biotechnology related inventions. He described the marine biotechnology investment landscape and presented an extensive global overview on public investments in marine biotechnology. **Helena Vieira** of the University of Lisbon addressed the innovation challenge and potential of marine biotechnology. She described scientists as entrepreneurs whose inventive skills can contribute to societal expectations from marine biotechnology to be met. She indicated where the critical innovation points emerged and further elaborated on how successful entrepreneurship and innovation could be achieved.

From a commercial perspective, access to and the right to exploit marine organisms is important. **Arianna Broggiato** of Université catholique de Louvain described the relevance of the Nagoya protocol and the relevance of the access and benefit sharing directive to marine biotechnology. She explained the new jurisdiction now being implemented and gave some specific examples on how the regulatory set-up could be handled at all levels of property rights and protection. **Catherine Boyen**, CNRS-UPMC, Roscoff, France, made a presentation ‘Setting the scene for Training and Education’ where she outlined why training and education is such an important issue for marine biotechnology. The ERA-MBT recognises the need for improved training and education within marine biotechnology, and has launched a web based survey on the mapping of existing training and education as part of a gap analysis.

During the summer of 2014, ERA-MBT launched an “on-line” questionnaire inviting submissions from stakeholders about technical transfer practice and policy, funding issues, access to infrastructures and IPR/IPP matters. Insights from this process will feed into the strategic roadmap. The preliminary results from the survey were presented at the stakeholder meeting by **Sigurdur Björnsson**, RANNIS, Iceland. Among actions identified was the need to bridge the gap between academia and industry, and to provide better access for SMEs to existing infrastructures.

## WHERE DO WE GO?

ERA-MBT has already embarked on a process that is designed to deliver a strategic roadmap for marine biotechnology. Under the headline ‘Where do we go’, the feedback from stakeholders at this meeting constitutes an important input to the process of developing the strategic roadmap. The structure of the workshop provided three formal mechanisms to allow feedback from participants; through question and answers after the formal presentations, responding to the questions presented to the participants in a break-out session, and discussions during the open roundtable forum discussion at the end of the stakeholder meeting.

To fully reflect the diversity of the feedback, stakeholder comments/feedback were organised under generic headings that capture the many opportunities to maximise the use of marine biomass; describe new product markets and end uses for marine derived materials; research infrastructure; marine biomass production and processing; new policy initiatives; funding requirements and modalities and human resource development. For each of these headings a number of bullet points were recorded, highlighting the feedback from the stakeholders.



A specific question asked at the break-out session involved participants being challenged to identify and describe possible future scenarios for marine biotechnology. A summary of the participants' response is presented in the report under the generic headings 'Scientific and technological conditions', 'Supporting infrastructure', 'Market development' and 'Policy and funding climate'.

## NEXT STEPS OF MARINE BIOTECHNOLOGY ERA-NET

The first of the ERA-MBT research calls was announced during the Lisbon Workshop. In his introduction to the announcement of the call for research proposals, Steinar Bergseth, coordinator of ERA-MBT, explained the aims and the background of the first call. Marta Norton, FCT, Lisbon, gave details of the practicalities and procedures of the call and explained how participants could apply to the call. A total of 14 funding agencies from 11 countries/regions committed around 8 M Euro to support projects that will be selected in a two-step application procedure.

Participants welcomed the broad theme of this call – 'The Development of Biorefinery Processes for Marine Biomaterials'. The ERA-MBT project plans to announce further research calls and the Lisbon workshop provided the opportunity for a broad cross section of researchers and industrialists to contribute ideas and suggestions for themes and topics to be included in future research calls. A summary of the stakeholder feedback is listed in the report where several research themes and topics are proposed, and valuable inputs to how the administration of research calls could be improved were also received.

All the stakeholder feedback will be used to inform the future activities of ERA-MBT.

Topics highlighted during the discussion on future calls included:

- Sampling marine material and sampling protocols;
- The challenge of upscaling from discovery to commercial exploitation;
- A need for new financial instruments to stimulate enhanced research-industry and industry-industry collaboration;
- Using future calls to focus efforts towards elements in the value chain.
- Creating greater visibility of marine biotechnology;
- Providing methods that stimulate more young researchers to engage in marine biotechnology.

Overall, the stakeholder event was considered as highly successful in addressing strategic issues that will be taken into account for further developing ERA-MBT and providing participants with the opportunity to expand their research and other collaborative networks.

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# INTRODUCTION

The first Stakeholder meeting of the Marine Biotechnology ERA-NET (ERA-MBT) was a chance to influence the future of the ERA-MBT as it seeks to expand and to reinforce the network of researchers, industry, policy makers and funding agencies to support the development of European marine biotechnology. This interactive event was open to scientists, companies, policy makers/advisors and other key individuals involved in or interested in furthering European Marine Biotechnology research and development.



The longest bridge in Europe; the Vasco da Gama bridge in Lisbon, close to the venue where the first ERA-MBT stakeholder meeting was held.

The meeting was held in Lisbon, Portugal, on the 28th and 29th October of 2014, hosted by the Portuguese Foundation for Science and Technology (FCT). This successful meeting attracted 100 participants from a mix of industry, funding agencies, policy makers/advisors and research delegates. Interactive sessions gave a chance for participants to provide feedback on opportunities and challenges for ERA-MBT to stimulate marine biotechnology research and innovation. The event comprised three headline sessions:

- I) State of the Art of Marine Biotechnology**
- II) Where do we go?**
- III) Next steps of Marine Biotechnology ERA-NET.**

This report describes various aspects of the state of the art of marine biotechnology; feedback given by the stakeholders on the question of “Where do we go” and results of roundtable panel discussion on the next steps for ERA-MBT.

Being the first stakeholder meeting arranged by ERA-MBT the feedback will be used in informing the future activities of the ERA-NET. As the first joint call was presented at the meeting, and the



topic had already been set, the management of ERA-MBT was very interested in listening to proposals from stakeholders for future call topics. The chapter “Next steps of Marine Biotechnology ERA-NET” provides a summary of this feedback.

Coinciding with the announcement of the first call, ERA-MBT launched a “match-making” service to assist applicants to find potential partners for research consortia. This service will be continued for the life of the ERA-MBT. Details of how to use the partnering platform are available on the ERA-MBT homepage<sup>1</sup>.



Participants at the ERA-MBT first Stakeholder meeting in Lisbon, 28-29 October 2014.

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<sup>1</sup> <https://www.submission-marinebiotech.eu/partner-search>

# STATE OF THE ART OF MARINE BIOTECHNOLOGY

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Invited speakers set the stage for the stakeholder meeting in presenting their view of the ‘state of the art’ of marine biotechnology. These contributions echoed the title of the meeting ‘Waves of Innovation’, - ‘Integrating National Efforts to Build the Future of Marine Biotechnology’ and in doing so reflected the goals of the Marine Biotechnology ERA-NET.

In his welcome address and introduction **Steinar Bergseth** of the Research Council Norway, the coordinator of the ERA-MBT project, invited the stakeholders to actively participate in the debate and to contribute ideas on future ERA-MBT activities that would make marine biotechnology a significant driving force in shaping the future of Europe. He elaborated on the content of marine biotechnology and the biotech toolbox versus market drivers seen as developing the field.

## POLICY PERSPECTIVE

**Jacques Fuchs**, Deputy Head of Unit F4 - Marine Resources, DG Research and Innovation, European Commission, described the range of EC support actions that contribute to marine and maritime development, and how the Jean-Claude Juncker led Commission, provides many new opportunities for marine biotechnology, since funding for top-level research not only creates jobs, but also ensures that technological progress gives a boost to the economy. He further stressed the mission of the newly created Marine Unit within DG Research; this mission included not only the desire to enhance the competitiveness of Europe in the global “blue economy”, it also implied the need to develop a strategic outlook to achieve the short, medium and long-term objectives that *inter alia* included enhancing marine research and innovation performance leading to Europe becoming a global reference point for such activities. EU support for unlocking the potential of the seas and oceans comes from initiatives in Horizon 2020, through calls that include dedicated marine biotechnology themes.

## PRODUCT OPPORTUNITIES

In an enlightening presentation, **Torger Børresen** of Innovation Fund Denmark, the Danish ERA-MBT partner, highlighted the market penetration of products originating from the marine environment in areas such as biomaterials, food, pharmaceuticals, etc. He emphasised the market potential may be significantly expanded by developing a deeper understanding of the marine environment and the options to maximize the use of marine biomass. The adoption of an even-more strategic approach that would support a “market driven approach” to marine biotechnology would bring a greater research focus to marine biotechnology, particularly, the application areas outside the marine sector such as food, health, materials and biomass production. He emphasized that upscaling from lab to industrial scale should be given much consideration for successful commercialization to be obtained. He further that for an optimal use of any raw material it would be necessary to target

several markets in a multi-stream processing approach. This might call for specialized processors to work together in clusters, targeting different applications and markets for better support of the European bioeconomy.

## INTERNATIONAL MARINE BIOTECHNOLOGY ACTIVITY

**Rachael Ritchie**, Director, Business Development, Genome, British Columbia in Canada provided an international perspective on the state of the art of marine biotechnology. In a wide-ranging and stimulating talk, she covered all aspects of the marine biotechnology value chain from addressing the need for expanding the –omics toolbox to the investment potential, governance challenges, sustainability and impacts on global needs. Developing a strategic response to rapidly changing and diverse environments such as those served by marine biotechnology is a challenge. It requires a constant monitoring of the various markets in order to develop an understanding of where organisations fit in and a constant assessment of future opportunities. She described how the landscape for marine biotechnology has changed since the 1990's as our understanding of ocean bioresources deepened and interest in exploiting marine biotechnology to unlock their potential increased. New markets for marine biotechnology products are opening up and according to Dr Ritchie will continue to do so; many enabled by the adoption of new research and technology platforms that include – big data analytics, genomics, synthetic biology; the evolution of new tools; and enhanced recognition of the potential of marine biotechnology to contribute to meeting global needs for food production, human and animal health and novel materials.

## BIOPROCESSING CHALLENGES

An insightful and entertaining contribution to the stakeholder event, **Dagmar Stengel**, National University of Ireland Galway, showed how algal biomass on one side is an excellent material for biorefining into a range of products, and on the other side, the ecosystem services they offer. She pointed to the need to understand these systems in order to use them sustainably in building the bioeconomy. She strongly pointed to the concept of a strategy for marine biotechnology. This was in the context of describing the challenges in biorefining marine biomass, specifically algal biomass, where eventual success was ultimately dependent on early, clear and correct choices that matched process to desired products; and where these were each appropriate to particular algal species.

## A STRATEGIC DIMENSION TO MARINE BIOTECHNOLOGY

**Dermot Hurst** from Ireland's Marine Institute provided insights to progress made over recent years in developing Europe's marine biotechnology community. He pointed to the challenges faced by ERA-MBT in developing a strategic roadmap for marine biotechnology including understanding how and where marine biotechnology can add value to marine biomass and enable a shift from commodity to niche products. Developing new insights from across the scientific, policy and industrial communities in events as this stakeholder meeting will enhance our understanding of the

contribution of marine biotechnology across many industry sectors, and help to shape new funding mechanisms to support collaborative research.

Dr Hurst was a member of the expert panel that met in Bremen in 2007 to discuss the future of marine biotechnology and produced the report from that meeting for the EC<sup>2</sup>. Despite the excellent progress by way of increased visibility of marine biotechnology, new policy direction and dedicated research funds for marine biotechnology and related research, many of the challenges highlighted in Bremen remain. Amongst the most challenging of these and the focus of the ERA-MBT objectives and the development of a strategic roadmap are defining and prioritising Europe's future marine science and marine biotechnology research activity; securing a greater participation by industry as a potential user of outputs from marine biotechnology research; improving the funding and co-ordination of marine science and targeting resources at marine biotechnology; and encouraging Europe's best scientists to engage in marine biotechnology research.

## INVESTMENTS IN MARINE BIOTECHNOLOGY

**Meredith Lloyd-Evans**, Managing Director Biobridge Ltd, in his presentation 'Who is investing in Marine Biotechnology', outlined a diverse international commercial landscape of marine biotechnology and described how investments can help SMEs to grow on the back of marine biotechnology related inventions. He gave an overview of what the investment landscape looked like and presented an extensive overview on public investments in marine biotechnology all over the world. Considering different streams for marine biotechnology production he illustrated how successful commercial development had been achieved in each of the streams, covering bioprospecting, functional food and cosmetics, novel enzymes, algal technologies and upgrading of fisheries and aquaculture by-products.

## MARINE BIOTECHNOLOGY – AN OPPORTUNITY TO INNOVATE

**Helena Vieira**, of the University of Lisbon addressed the innovation challenge and potential of marine biotechnology in describing scientists as entrepreneurs whose inventive skills need to be realised to meet the societal expectations from marine biotechnology. She raised the central question 'how do you go from science to market'? Reflecting how business cycles moved from short to long term growth, she indicated where the critical innovation points emerged and further elaborated on how successful entrepreneurship and innovation could be achieved. In principle the innovation processes in marine biotechnology is not substantially different from other sectors, so a lot may be learned from what has been achieved elsewhere. The most important point is to have the right people and to train entrepreneurial minded marine biotechnology scientists.

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<http://www.marinebiotech.eu/sites/marinebiotech.eu/files/public/library/MBT%20publications/2007%20Bremen%20Marine%20Biotechnology.pdf>

## ACCESSING MARINE RESOURCES

**Arianna Broggiato** of Université catholique de Louvain described the relevance of the Nagoya protocol and the relevance of the access and benefit sharing directive to marine biotechnology. She explained the new legislation now being implemented and gave some specific examples on how the regulatory set-up could be handled at all levels of property rights and protection. A practical guide would comprise several steps for collectors, which she outlined in her presentation. She further stressed the importance of those involved in related research to continue to deepen their understanding of future responsibilities regarding access and benefit sharing.

## TRAINING IN MARINE BIOTECHNOLOGY

**Catherine Boyen**, CNRS-UPMC, Roscoff, France, made a presentation ‘Setting the scene for Training and Education’ where she outlined why training and education is such an important issue for marine biotechnology. She referred to several reports and recommendations having emphasised marine biotechnology as a rather ‘young’ research and development area, it is very important that specific educational offers are presented to students and young researchers. One central recommendation of the Marine Board Position Paper 15<sup>3</sup>, stated that ‘training the next generation of marine biotechnologists must focus on the use of interdisciplinary and holistic approaches to solve technological problems specific to dealing with marine organisms and the marine environment’. The CSA MarineBiotech that preceded the ERA-MBT also emphasised that the ERA-MBT should support training activities such as master classes, courses, summer schools, etc. on marine biotechnology related topics.

The ERA-MBT recognises the need for improved training and education within marine biotechnology, and has launched a web based survey to map existing training and education as part of a gap analysis. During her presentation, Catherine illustrated the survey content and how to respond to it. Following the analysis of the responses, a list of training options will be made available via the ERA-MBT homepage.

The break-out session asked specific questions on education (Table 10, Annex 3). The feedback from this session is summarised in the chapter ‘Human resource development’ in this report.

## INDUSTRY FEEDBACK, AN ON-LINE QUESTIONNAIRE

During the summer of 2014, ERA-MBT launched an “on-line” questionnaire inviting submissions from stakeholders about technology transfer practice and policy, funding issues, access to infrastructures and IPR/IPP matters. Insights from this process will feed into the strategic roadmap.

The preliminary results from the survey were presented by **Sigurdur Björnsson** from RANNIS, Iceland. Respondents from 24 countries represented a range of stakeholders from both the public and the private sector; about 80% of the industry contributors describing themselves as SMEs. Whilst

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<sup>3</sup> <http://www.esf.org/publications/marine-sciences.html>



these firms processed different types of biomass, the majority of products produced related to the food/feed market and the health, pharmaceutical and cosmeceutical markets. The major bottlenecks to funding were seen as limited access to domestic public funding, and to EU/international funding. Among actions identified was the need to bridge the gap between academia and industry, and to provide better access for SMEs to existing infrastructures.



Participants during the plenary session at the first ERA-MBT Stakeholder meeting in Lisbon.

# WHERE DO WE GO?

## A STRATEGIC APPROACH TO MARINE BIOTECHNOLOGY

ERA-MBT has already embarked on a process that is designed to deliver a strategic roadmap for marine biotechnology. Underpinning this strategic process is a broadly agreed vision for ERA-MBT; *to support Europe's marine biotechnology community to participate in a lasting enterprise-driven network that adds value to marine biological resources in ways that nurture and sustain the lives of European citizens.*

The feedback from stakeholders at this meeting constitutes an important input to the process of developing the strategic roadmap. The challenge of developing marine biotechnology capabilities is thus not new. European policy and industry interests, together with a diverse and active research community, engaged in different actions designed to clarify, and ultimately define, the steps needed to make the promise of marine biotechnology a reality. Over recent years the EU and the Marine Board assumed a lead role in seeking a more strategic approach to the evolution of marine biotechnology. Since the publication of the Marine Board Position Paper 15<sup>4</sup>, the EU sought to clarify marine biotechnology in the context of a broader bioeconomy and subsequently in a more targeted policy outlook on the marine sector within an overarching strategy termed “Blue Growth”.

The ERA-MBT strategic planning process is further supported by activities to secure feedback from the ERA-MBT including an extensive desk study, completed as part of the ERA-MBT project; contributions from an International Advisory Group and a planned foresight exercise termed OUTLOOK, which will consider how marine biotechnology might contribute to the realisation of the societal challenges that face Europe in 2030.

## STAKEHOLDER FEEDBACK

The structure of the workshop provided three formal mechanisms to allow feedback from participants.

- Ample time for question and answers afforded opportunities for debate after the formal presentations and key-note talks.
- Responding to the questions presented to the participants in a break-out session.
- The open roundtable forum discussion at the end of the stakeholder meeting.

The break-out session followed the ‘world-café’ model, where participants were asked to visit seven different tables (from a total of ten) for group discussions on present questions, according to a pre-set schedule. The questions discussed in the break-out are presented in Appendix 3 to this report.

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<sup>4</sup> <http://www.esf.org/publications/marine-sciences.html>

During the break-out session, participants described a wealth of opportunities to investigate and make use of marine origin bioresources. In doing so, they described areas of opportunity, many of which were far removed from typical marine applications. The approach of focussing on industry sectors that could utilise marine biotechnology enabled products and processes, significantly expands the spread of end-use/applications away from traditional areas. This shift in outlook was accompanied by a perspective that sees marine bioresources as offering unique opportunities; worthy of exploring in their own right, as opposed to looking upon them as a source of terrestrial equivalents.



Participants during the break-out sessions at the first ERA-MBT Stakeholder meeting in Lisbon, which was a chance for participants to influence the future of the ERA-MBT.



The roundtable discussion in which the workshop participants interacted with the panel members on the future challenges and opportunities for ERA-MBT.

The roundtable discussion was moderated by **Dermot Hurst**. In his introduction he encouraged the audience to provide feedback that could be used in further planning the strategic roadmap. Supporting this interaction was a panel of members of the ERA-MBT project - **Petra Schulte**, Jülich, Germany, **Catherine Boyen**, CNRS-UPMC, Roscoff, France and **Sigurdur Björnsson**, RANNIS, Iceland. Each of the panel members made short statements inspiring the roundtable dialogue with the audience.

Participants provided extensive feedback throughout the workshop by the different mechanisms outlined above. To fully reflect the diversity of the feedback, stakeholder comments/feedback are organised under generic headings that seek to capture the many opportunities to maximise the use of marine biomass; describe new product markets and end uses for marine derived materials; research infrastructure; marine biomass production and processing; policy initiatives; funding requirements and modalities and human resource development.

## Opportunities to maximise the use of marine biomass

With the marine environment widely recognised as a unique space capable of yielding unique bioactive molecules, the search for novel materials from marine organisms continues. The development of devices such as remotely operated vehicles is behind a renewed focus on bioprospecting. It is now possible to both observe and capture marine organisms from the ocean floor. Expanding the exploration of marine environments (some of which had previously remained out of reach), is beginning to provide researchers with access to materials from novel marine organisms. Traditional and more accessible biomass includes algae – both macro and micro-algae, finfish and shellfish. However, despite the familiarity of these materials, they still offer considerable scope for the discovery of novel bioactives and other materials and remain high on the research agenda. The pressures on stocks as a result of wild harvesting marine species were not viewed as sustainable, whilst managed and controlled culturing offered significant benefits, including the potential to adjust or manipulate the production of bioactives. Opportunity areas identified by participants included:

- Bacteria from deep sea sediments
- Microbial symbionts from sponges and other organisms
- Marine fungi
- Macro and micro algae
- Fish processing discards
- Sponges, cnidarians and other marine invertebrates
- Bivalves (clams, oysters, mussels, scallops, worms etc)

## New product markets/uses for marine derived materials

Only a small fraction of marine biomass is presently used outside the food and feed sectors. The workshop challenged the traditional view of marine biotechnology as limited in applications and constrained to existing markets, by identifying emerging opportunity areas and completely novel applications for marine derived compounds. The healthcare sector, with some degree of success, targeted marine derived molecules as new pharmaceutical entities, as did the nutritional food ingredients/supplements sector in developing functional ingredients and nutraceuticals. The marine is home to a myriad of exotic biological materials that may inspire biomimetic materials of interest to the engineering and medical devices sectors. Not only is the marine proving to be the source of new product applications, considerable scope exists for the marine to contribute new processing methods. The range of biodiversity found in the marine environment is an excellent source of diverse biocatalysts. Initially pioneered by the foods sector, marine derived enzymes have attracted the attention of the chemical, pharmaceutical, cosmetics, agriculture and environmental sectors. The broad potential use of marine derived materials is reflected in the range of applications identified by stakeholders and described below.

- Biopolymers for use in medical and engineering applications
- Enzymes for food, pharmaceutical and other process applications
- Biosensors based on marine organisms and derived materials
- Food and nutritional ingredients for human and animal health
- Aquaculture feedstock
- Anti-fouling compounds



- Compounds for cosmetics and cosmeceuticals
- Nutraceuticals and nutritional supplements
- Medical devices, including drug delivery, bone and tissue replacement/reinforcement
- Regenerative medicine
- High performance adhesives
- Nanomaterials and nanotechnology
- Environmental remediation and waste recycling
- Model organisms and biological assays
- Pharmaceutical compounds and fine chemicals
- Traceability of marine food products

## Research infrastructure requirements

Developing and maintaining a marine biotechnology community, which attracts and embraces researchers of different disciplines, faces many challenges. Establishing a platform between researchers and the array of end-users is essential in stimulating innovation. Rightly, expectations about enhancing the available research infrastructure to support product and process innovations have to be met; so too must access to essential core infrastructure. Opening up, expanding and creating new infrastructure will serve to broaden marine biotechnology research activity as well as attract industry collaborations. Stakeholder feedback highlighted the following areas as priorities in reinforcing Europe's marine biotechnology infrastructure.

- Create a European marine bioresources database including the results of all evaluations and bioassays of compounds
- Establish repositories for marine organisms, extracts and molecules
- Develop common collection and sampling platforms
- Provide new tools to support "rapid" screening activity
- Broaden use and knowledge of "omics" in marine biotechnology and in screening
- Create environments that enable the production of targeted secondary metabolites
- Develop diagnostic tools to assess structural and functional characteristics of organisms
- Strengthened bioinformatics support for marine
- Large scale infrastructure – research vessels, ROVs, for deep water and other collection/sampling platforms, e.g. autonomous vehicles for seabed sampling
- Enhanced knowledge of the diversity and distribution of marine organisms in European waters

## Marine biomass production and processing

Marine biomass comprises many forms. Typically whole fish, discards from fish capture, farming and processing, and macro-algae formed the major source of marine biomass. Increasingly, biomass reflects the diversity of marine biota including e.g. micro algae, marine invertebrates and marine microorganisms. Irrespective of the end application, the input to the value-adding conversion process is marine biomass. Securing sufficient biomass presents challenges, particularly if the sole source is wild stocks, where overexploitation can threaten the survival of species. Consistency, security and quality of supply have to be balanced in ways that address the environmental challenges. The well-managed and controlled culture of marine biomass, whilst similarly facing



production challenges, offers a more sustainable source of biomass. The constraints and opportunities of biomass processing and production, as identified by contributors to the workshop, point to wide-spread concerns regarding how biomass is cultured and harvested and from where as outlined below.

- Novel extraction techniques and facilities
- Pilot scale equipment for scale-up
- Selective cultivation and harvesting of marine biomass
- Develop customised reactor technology to simulate harsh/hazardous environments
- Use of nanotechnologies for the sampling of micro-organisms and molecules
- Molecular breeding
- Synthetic biology as applied to marine biotechnology
- Land based culture – including land based multi-trophic culture
- Common platforms for testing marine origin compounds
- Off shore and deep water aquaculture
- Novel hosts within which to cultivate microorganisms
- Enhanced metabolic engineering
- Creation of common reference/calibration methods for bioactivity
- Novel processing and processes to strengthen and enhance biorefining
- Broadened use of genomics to investigate macro- and micro-algae

## New policy initiatives

European policy concerning the bioeconomy generally, and marine biotechnology specifically, despite being well developed, is under constant and ongoing review. This positive approach to the provision of a policy framework to encourage and sustain the development of European based marine biotechnology activity was highlighted in invited presentations. The positive policy position on marine biotechnology is visible in elements of the Horizon 2020 work programme. This particular focus to the role of marine biotechnology research in respect of food security and health – both human and animal, and to bioprocessing, is an acknowledgement of the importance of generating new knowledge to support innovation. Cross-cutting marine research is at the heart of Horizon 2020, where new knowledge from supported projects, is seen as contributing to the European Commission “Blue Growth” initiative and to supporting high-value added products, long-term growth and jobs. Despite the strong policy footing underpinning marine biotechnology, participants identified further opportunities that could be realised, if supported by new policy direction: these included

- Support for the concept of a market for marine extracts
- Establish common regulatory frameworks for the harvesting and cultivation of marine bioresources
- Enhanced funding schemes to attract multi-disciplinary projects
- Policy to address the challenges of implementing the Nagoya protocols
- Build on existing bilateral agreements and stimulate agreements with specified countries
- Support for regional marine biotechnology activities and a common European information base
- Strengthening the understanding of marine biotechnology by public awareness

- Clarify ownership and use of marine bioresources, including rights to commercialise them
- Promote a common understanding of marine biotechnology
- Prioritise funding for marine biotechnology related infrastructure
- Create schemes to support smaller scale focused projects as a means of building research capacity
- Establish common rules to govern European research funds for marine biotechnology and encourage SME participation in projects
- Marine spatial planning to take account of marine biotechnology needs

## A collaborative environment for marine biotechnology

Knowledge, skills and creativity were identified as the core assets of the modern economy. Assets as these, that are critical to business success and economic performance, are the basis of marine biotechnology enabled innovation. Against this background, the traditional economic factors of labour and capital, according to participants, begin to diminish in importance. In the face of scientific and technological globalisation, stimulating interaction between researchers and industry was seen as contributing to innovation performance. The importance of a collaborative outlook and response was seen as crucial in enabling marine biotechnology based innovation. Major research support programmes increasingly encourage institutional and industry collaboration, which is indicative of the beneficial aspects of collaborative research in both the generation and application of knowledge. Stakeholder feedback provided many examples of opportunities for increased collaboration in marine biotechnology including,

- Establish links between Europe and leading biotechnology centres of the world
- Form strategic partnerships with specified countries
- Establish links and coordination activity between marine biotechnology related research platforms, e.g. other ERA-NETs
- Promote and support marine biotechnology research and innovation clusters
- Encourage and provide support for global collaboration including additional funds for ERA-NETs
- Involve industry associations such as EuropaBio in marine biotechnology initiatives
- Greater support for marine biotechnology proof of concept projects by SMEs
- Greater support to encourage European scale collaborative bioprospecting
- Use pre-competitive R&D projects as the basis for early stage collaboration
- Support for projects that include multi-disciplinary approaches to marine biotechnology projects, including activity that incorporates expertise from outside traditional marine biotechnology disciplines and industry

## Human resource development

The skills required to understand, harness and develop marine biotechnology initiatives are many. Whilst opportunities for “discovery science” exist in the marine biotechnology space, the skill sets required to realise them are changing. New analytical and visualisation techniques are being developed; many of which are applicable to marine biotechnology. Attracting researchers from other disciplines to apply their skills to marine biotechnology is important; but so too is ensuring training initiatives can support the development of people with the required competencies. Developing the

non-technical competencies to work within new organisational structures are equally important to possessing scientific or engineering skills to work on marine biotechnology projects. Participants considered education and training as relevant to the academic and business/industry environments and stressed the importance of marine biotechnology adopting new training methods. The following reflect the broad views of participants on marine biotechnology related education and training needs.

- To engage in activity that will clarify the role of education and training in support of marine biotechnology and identify centres and institutions across Europe that provide such supports
- Include modules on entrepreneurship and creativity in all post-graduate training
- Provision of “soft-skills” training for marine biotechnologists – project management, communications, teamwork
- Persons with expertise and backgrounds in biotechnology are relevant to marine biotechnology
- Marine biologists would benefit from training and exposure to biotechnology
- Provision of industrial placements for postgraduate level scientists and programmes to facilitate industry/academia exchange for more senior staff
- Development of dedicated initiatives designed to generate a greater awareness of the potential opportunities for marine biotechnology to contribute to society
- SMEs targeted in programmes that create awareness of opportunities to benefit from marine biotechnology research outputs
- Stimulate joint actions between industry and academe to define joint training needs

## Future possibilities, directions challenges and hurdles

A specific question asked at the break-out session involved participants being challenged to identify and describe possible future scenarios for marine biotechnology (Table 8, Appendix 3). The context to this activity was a foresight type exercise being planned by ERA-MBT. Participants in the break-out session were invited to consider and discuss the “future possibilities, directions, challenges and hurdles” likely to impact on the development of marine biotechnology. A summary of the participants’ response, organised under generic headings, is given below.

### Scientific and technological

- Major developments in bioinformatics, sequencing and chemical analysis, including the development of enhanced visualisation techniques will enable an increase in the rate of discovery of new compounds
- “Omics” technologies will dominate future RTDI activity and create opportunities for the further development of the marine biotechnology toolbox, new products and industrial processes
- There will be a shift away from the serendipitous approach to marine biodiscovery to a more rational approach that is based on new predictive techniques to allow for improved targeting and better planning of sampling effort

## Supporting infrastructure

- The widespread availability of integrated open access databases, and repositories of biological and genetic resources will stimulate collaboration between researchers, industry players and between industry and researchers, all existing samples will be routinely archived for future research
- New financial instruments that stimulate inter-firm collaboration and also provide support for the facilitation of research/industry interaction will become available
- The various bottlenecks and other challenges encountered in scaling-up from laboratory to production level outputs will be solved and organisms previously considered as non-culturable, will be cultured
- Despite the likely RTDI process improvements, the need for industry to maintain a balanced portfolio of short, medium and long-term research and development projects targeting “low-hanging fruit” and blue-seas research will remain

## Market development

- Niche markets for marine derived and marine biotechnology enabled products will provide the greatest market opportunity for SMEs and these products will result from anticipated improved and faster RTDI cycles and the deployment of new research tools and infrastructure
- Priority areas for marine biotech research will remain health and food (human and animal) products with alga and fish production becoming the major sources of proteins for food use
- Society will remain sceptical regarding outputs from genetic research and its impact on food, health and the environment

## Policy and funding climate

- The expectations surrounding the impact and contribution of marine biotechnology to economic and societal progress in general will be better managed, leading to high levels of confidence in industry and amongst consumers, concerning marine biotechnology enabled products and processes
- A wide acceptance of the concept of “open innovation” will enable a wider use of marine biotechnology based materials in novel products and processes
- Marine special planning etc will have recognised, taken into account and created space for marine biotechnology and in doing so will establish marine biotechnology as contributing to the development of balanced development within coastal regions

# NEXT STEPS OF MARINE BIOTECHNOLOGY ERA-NET

Feedback from the stakeholder workshop will be used to inform future activities of the ERA-NET. In the first instance, feedback from the Lisbon meeting will contribute to defining the strategic roadmap. The experiences in managing the first call will influence any future calls from ERA-MBT; and responses from surveys on industry needs, training opportunities and findings of the ERA-MBT foresight process termed OUTLOOK will each contribute to the question of “Where do we go?”

## MARINE BIOTECHNOLOGY RESEARCH PRIORITIES

### Managing the first call for research proposals



Steinar Bergseth, explaining the aims and background of the first call.

The first of the ERA-MBT research calls was announced during the Lisbon Workshop. In his introduction to the session where the call was presented, **Steinar Bergseth**, coordinator of ERA-MBT, explained the aims and the background of the first call. A major aim would be to bring together basic, applied, technology and market driven research approaches, and further to develop new and/or improved biotechnological knowledge, tools and methods for the sustainable processing of marine biomass. The final target would be to obtain a variety of bio-based products and/or services through

integrated biorefinery processes ideally utilising all molecular fractions present in the relevant biomass.

**Marta Norton** from FCT, Portugal, gave a detailed presentation on the practical details and administrative procedures connected with the first call and explained how participants should make applications. A total of 14 funding agencies from 11 countries/regions agreed to contribute a total of €8 million to stimulate marine biotechnology research. The final outcome of what is a two-step application and evaluation process is expected by end of July 2015. Lively discussions between prospective partners' intent on bidding for a slice of the funds from the first call for research proposals were a feature of coffee breaks.

### Future research calls

Participants welcomed the broad theme of this call – ‘The Development of Biorefinery Processes for Marine Biomaterials’. The ERA-MBT project plans to announce further research calls as the project progresses. A range of inputs will influence the content of these future calls including the ERA-MBT



strategic roadmap, industry questionnaires and direct feedback from stakeholder events. The Lisbon workshop provided the opportunity for a broad cross section of researchers and industrialists to contribute ideas and suggestions for themes and topics to be included in future research calls.

## Stakeholder feedback on calls and projects

During the round table discussion participants made valuable contributions concerning the promotion and administration of research calls and future call topics. A summary of the stakeholder feedback, reflecting the views of industry, policy and research communities is given below.

### Research themes and topics

- The sustainable production of biomass; including marine animals, algae, bacteria etc. with a view to delivering secure and high quality supplies of biomass that meet the requirements of the processing/refining sector
- Demonstrate the use “state of the art” tools and methodologies to obtain genetic information, including whole genomes, of marine species of commercial interest
- Marine biotechnology projects can encounter problems in shifting from laboratory to pilot scale, hence there is a need to investigate the challenge of up-scaling biomass production
- There are many opportunities to target existing markets in the human and animal food, feed, nutritional ingredients and ingredients for cosmetics; projects that target these so-called “low-hanging fruits” can demonstrate benefits of marine biotechnology as well as generate early cash flows.
- The development and use of new tools and analysis methods to support molecular aquaculture
- Provide test and demonstration sites for biorefining and other capital intensive processing of marine biomass and make them available to a broader potential user base.
- Use of high throughput screening and analysis methods for marine extracts – targeting biochemical functionality
- Create a pilot marine biomaterials repository and supporting database providing details of organisms, extracts and performance of bioactives and other compounds as the “blue-print” for network repositories and define the requirements for a common European marine bioresources database.
- Support the creation of links to other networks where competencies are relevant to the objectives of marine biotechnology – e.g. supporting the production of marine biomass or providing access to large scale research infrastructure.
- Support projects that involve interaction of ERA-MBT with industrial biotechnology ERA-NETs in ways that enable marine biotechnology projects to gain access to the array of tools, techniques and methodologies
- Provide funds to support for marine biotechnology proof of concept studies.
- Fund research facilities to open access to industry to engage on joint projects

## Administration of research calls

- Establish ERA-MBT as an information and knowledge hub for communication and interaction with researchers and industry, building links to other ERA-NETs and networks links to with information sources.
- Identify and support potential partners from outside Europe to participate in ERA\_MBT projects with a view to strengthening European marine biotechnology research.
- Ensure project submissions are more specific (more definition of tasks, sub-tasks, deliverables etc) and project teams more accountable for the delivery of agreed results, by introducing stricter project management guidelines.
- Increase the scope for industry to participate at all stages in the definition and approval of ERA-MBT projects.
- Create a separate fund that would encourage the next generation and emerging high-potential research to lead marine biotechnology projects.
- Support innovative ERA-MBT researchers to form links with a company including spending time located within companies where knowledge transfer would be rewarded by exposure of the researcher to in-company business/commercial activity.
- Support Erasmus Mundus master degree in Marine Biotechnology
- Support promotion and awareness creation projects, including the award of a European wide prize to a high-performing emerging marine biotechnology researcher

In summary, the stakeholder event was considered as highly successful in highlighting strategic issues that will be taken into account in further developing ERA-MBT and also providing participants with the opportunity to expand their research and other collaborative networks. Some of the major issues highlighted in the open forum reflect the diversity of the large and enthusiastic attendance including ,

- Sampling marine material and sampling protocols;
- The challenge of upscaling from discovery to commercial exploitation;
- A need for new financial instruments to stimulate enhanced research-industry and industry-industry collaboration;
- Using future calls to focus efforts towards elements in the value chain;
- Creating greater visibility of marine biotechnology; and
- Providing methods that stimulate more young researchers to engage in marine biotechnology.

Presentations, a news report and a photo gallery from the stakeholder meeting are available at [www.marinebiotech.eu/stakeholder-meeting](http://www.marinebiotech.eu/stakeholder-meeting).

## APPENDICES

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### APPENDIX 1: PROGRAMME

#### First Marine Biotechnology ERA-NET Stakeholder Meeting

##### WAVES OF INNOVATION

*Integrating National Efforts to Build the Future of Marine Biotechnology*

28<sup>th</sup> - 29<sup>th</sup> October 2014, [Olissippo Oriente Hotel, Lisbon, Portugal](#)

#### Tuesday 28 October 2014

##### Session 1 State of the Art of Marine Biotechnology

Chair: Steinar Bergseth

09:00 *Welcome to meeting and introduction to Marine Biotechnology*  
Steinar Bergseth, RCN, Norway, Coordinator

09:30 *Introduction to Marine Biotechnology – The market driven approach*  
Torger Børresen, IFD, Denmark

10:00 *Vision on marine biotechnology Research and Development as seen from the European Commission*  
Jacques Fuchs, Deputy Head of Unit, DG RTDI, Marine Resources

10:30 Coffee break

11:00 *Marine Biotechnology: Enabling Solutions for Ocean Productivity and Sustainability*  
Rachael Ritchie, Director, Business Development, Genome British Columbia, Canada

11:40 *The results, conclusions and further needs in the ERA-MBT stakeholder survey*  
Sigurdur Björnsson, RANNIS, Iceland

12:00 Buffet Lunch & networking

## Session 2 Where do we go?

Chair: Torger Børresen

14:00 *Requirements for successful innovation from marine biotechnology*

Helena Vieira, Consultant, SELF, Faculty of Sciences, University of Lisbon

14:30 *Access and benefit sharing according to the Nagoya protocol – what does it mean for marine biotech?*

Arianna Broggiato, Postdoctoral Researcher, Université catholique de Louvain.

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15:00 *Workshop sessions in break-out groups*

Participants will be presented with specific topics to express their views on. The ERA-MBT will analyse and incorporate these as appropriate in the development of new calls, communications and strategies.

17:30 *Plenary Sum up of ideas from the workshop sessions*

Torger Børresen, IFD, Denmark

19:00 Buffet dinner & Networking

**Panoramic room – Tivoli Oriente, Av. Dom João II, nº 27**  
(Across the street from Olissippo)

## Wednesday 29 October 2014

### Session 3 Next steps of Marine Biotechnology ERA-NET

**Chair: Dermot Hurst**

09:30 *Aims of the first ERA-MBT call*

Steinar Bergseth, Coordinator ERA-NET MarineBiotech

09:45 *Keynote presentation on Biorefinery of marine biomass*

Dagmar Stengel, National University of Ireland Galway, Ireland

10:15 *Who are investing in marine biotech?*

Meredith Lloyd-Evans, Managing Director Biobridge Ltd

10:35 *How to participate in the first call – practical details and procedures*

Marta Norton, FCT, Portugal

11:00 Networking coffee break

11:30 *Setting the scene for Training and Education*

Catherine Boyen, CNRS, France

11:50 *Challenges for a Strategic Roadmap on marine biotechnology*

Dermot Hurst, Marine Institute, Ireland

12:15 *Roundtable discussion of proposed conclusions from the workshop session at day 1*

Moderator: Dermot Hurst, Marine Institute, Ireland

Participants: Representatives from academia and industry

12:50 *Wrap up & next steps*

Steinar Bergseth, RCN, Norway, Coordinator

13:00 *Adjourn & lunch*

A 'wishbox' will be provided at the conference venue, where participants can post written statements for future actions.



## APPENDIX 2: PARTICIPANTS LIST

### List of participants

First Marine Biotechnology ERA-NET Stakeholder Meeting

#### WAVES OF INNOVATION

*Integrating National Efforts to Build the Future of Marine Biotechnology*

28<sup>th</sup> - 29<sup>th</sup> October 2014, [Olissippo Oriente Hotel, Lisbon, Portugal](#)

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 BARBAS Julio, Ministry of Economy and Competitiveness (MINECO), Spain  
 BAVINGTON Charles, GlycoMar Limited (GlycoMar), United Kingdom  
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 BØRRESEN Torger, Danish Agency for Science, Technology and Innovation (DASTI), Denmark  
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 WALLER Uwe, University of Applied Sciences Saarbruecken (HTW SAAR), Deutschland

## APPENDIX 3: QUESTIONS FOR BREAK-OUT SESSIONS

*Table 1*

**What tools, techniques, processes and methods are required to support the development of marine biotechnology?**

Table Chair Uwe Waller, Co-Chair Margret Geirsdottir

Background: The development of new tools within molecular biology, like different -omics, is considered important for the toolbox needed to release the full potential within marine biotechnology. We would like to have views of which of such methods are the most important to take up or develop further, and which adaptations that are needed for applications within marine biotechnology. Other techniques, like e.g. in information technology, nanotechnology etc. may also be considered.

*Table 2*

**What are the opportunity areas for marine biotechnology and what resources should be targeted to realize these opportunities?**

Table Chair Adrianna Ianora, Co-Chair Julio Barbas

Background: The areas should support the development of the European bioeconomy, and can be considered from the viewpoint of sourcing or raw materials, microorganisms, or biomass like macroalgae, microalgae, etc. to derive specific proteins, carbohydrates, lipids, enzymes, etc. Another topic categorization can be product derived, like e.g. for pharmaceutical use, nutraceuticals, cosmetics, food or feed, or applications related to aquaculture etc.

*Table 3*

**Where along the value chains should marine biotechnology research effort be focused or targeted?**

Table Chair Sigurdur Björnsson, Co-Chair Renata Denaro

Background: When considering the development of a specific value chain, gaps are often experienced somewhere along the chain. It is known that transferring research results into commercial production presents many challenges that may make the original thoughts for a certain topic very difficult to pursue.

*Table 4*

**What are the relevant indicators that can be used for creating a marine biotechnology success?**

Table Chair Ernst Kloosterman, Co-Chair Inge Arents

Background: For any stepwise development of a product it is necessary to set up some indicators that should be monitored if the final result is to be a success. These requirements can be related to economical calculations relative to anticipated market price for given end products, or it could be consideration of certain risk factors or problems that needs to be solved for further progress. In addition to financial issues, technical issues or environmental or energy issues may also be important.

#### *Table 5*

### **What barriers have to be overcome to enable the development of marine biotechnology based products, processes and services?**

Table Chair Adrianna Broggiato

Background: International collaboration may present some problems related to sourcing of the raw material, i.e. in which areas are the organisms or a given gene pool originating? Are there questions of jurisdiction that should be considered? The right of ownership is another area that may be of general concern. Are such concerns specific for marine biotechnology or are they general for all technical developments?

#### *Table 6*

### **How can collaboration with marine biotechnology stakeholders outside Europe create added value to marine bioresources and the development of the toolbox?**

Table Chair Meredith Lloyd-Evans, Co-Chair Rachel Ritchie

Background: The present project is an ERA-NET, which is suitable for creating added value within European marine biotechnology. Are there non-European countries with specific MBT know how advances which Europe could profit from? How could projects and strategies be framed to achieve the added value embedded in such transnational co-operations and create win-win relations?

#### *Table 7*

### **What other European collaboration and funding instruments are relevant to contact for an extended networking of ERA-MBT?**

Table Chair Petra Schulte, Co-Chair Marta Norton

Background: The ERA-MBT has a given work programme, where a strategic roadmap is being developed and the final goal is to create a lasting network that is active after the present 4 year project period is finished. There are many other collaboration instruments like ERA-NETs, JPIs, etc. being active at the time when ERA-MBT is running. Which of these instruments should be considered for a closer collaboration in order to pursue the goal of ERA-MBT?



*Table 8*

**What are the future possibilities, directions challenges and hurdles?**

Table Chair Dermot Hurst

Background: The ERA-MBT is doing a separate and dedicated foresight exercise (named OUTLOOK) to inform the roadmap we set out to deliver. We find it very useful to also use the present opportunity to do a brainstorming with you as stakeholders to get as many views as possible to feed both into the foresight process and also as background for the further ERA-MBT work. During the time available for the group, please come up with short statements on areas to work on, issues to address, gaps to fill, technical developments needed, societal issues to address, etc...

*Table 9*

**Are the current project funding instruments of the EU well aligned to drive marine biotechnology projects from good basic science through innovations, to proof of concept and added-value as products, processes and services?**

Table Chair Steinar Bergseth, Co-Chair Kim Turk

Background: The ERA-MBT is seeking to stimulate the creation of, and utilisation of, research based innovations. This requires development and uptake of applications in industrial and SME environments. The ERA-MBT wants to understand if there are funding instruments to develop for MBT that can stimulate this process to run smoother; maybe in particular the interface from an academic invention to its further development to an application in a market.

*Table 10*

**What education and training requirements need to be provided to support the development of marine biotechnology? Needs and gaps within training and education for MBT?**

Table Chair Catherine Boyen Co-Chair Fien De Raedemaeker

Background: A successful development of MBT is dependent on people with the right competences and understanding of the area, the methods and needs for multi-disciplinary approaches. This applies both to the academics and industrial environments. Where and how are new knowledge, training and interactions important to build for the best of MBT?